

Joint Research Centre (JRC)

The European Commission's
Research-Based Policy Support Organisation



Overview of the Institute for Transuranium Elements

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European Commission
President Barroso



Commissioner Potočník
Science and Research
over two DGs

(26 other Commissioners)

**Joint Research
Centre (JRC)**

**Research DG
(RTD)**

**Customer DGs:
Agriculture, Environment,
Enterprise, Safety
& Consumer Protection, etc**

INDEPENDENCE

from national, industrial and commercial interests

NEUTRALITY

an objective research at the service of Europe and its
institutions

SUBSIDIARITY

undertake activities that would benefit from a broad European
attention rather than merely tackled at local level

7 Institutes in 5 Member States \cong 2650 staff (+ 250 competitive)
 \cong 300 M€/y budget (+ 40 M€/y competitive)
124 scientific projects (called actions)



IE - Petten The Netherlands
- Institute for Energy



IRMM - Geel Belgium
- Institute for Reference Materials and Measurements



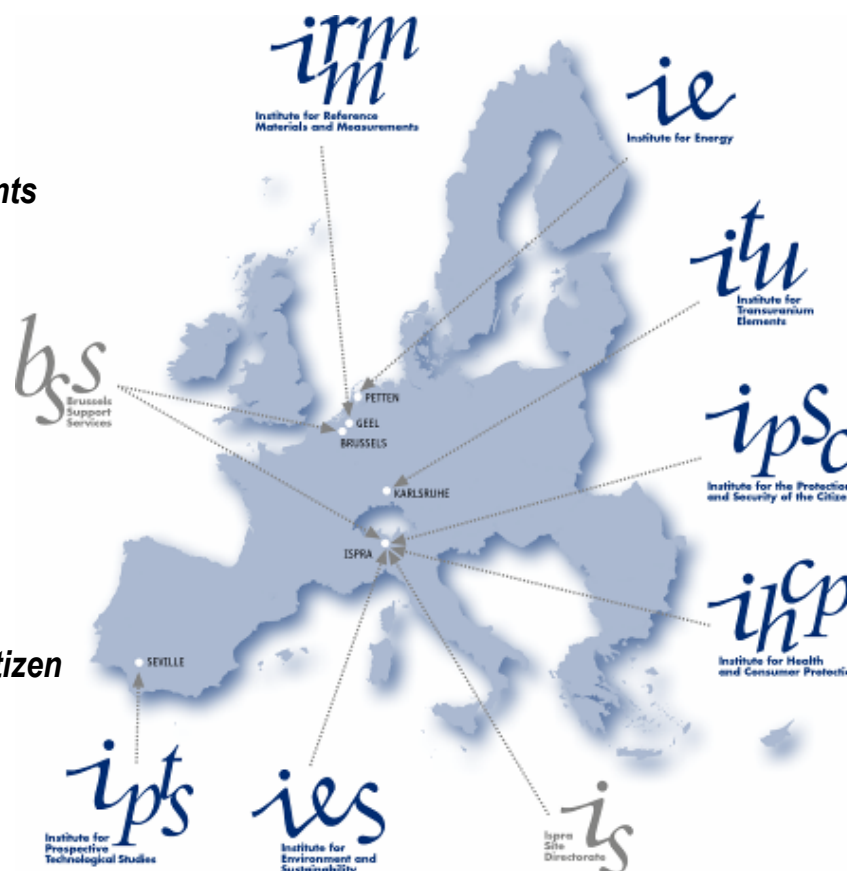
ITU - Karlsruhe Germany
- Institute for Transuranium Elements



IPSC - IHCP - IES - Ispra Italy
- Institute for Environment and Sustainability
- Institute for Health and Consumer Protection
- Institute for the Protection and Security of the Citizen



IPTS - Seville Spain
- Institute for Prospective Technological Studies



Mission: *to protect the European citizen against risks associated with the handling and storage of highly radioactive elements.*

Objectives:

- *to serve as a reference centre for basic actinide research*
- *to contribute to an effective safety and safeguards system for the nuclear fuel cycle*
- *to study technological and medical applications of transuranium elements.*

1963-2003

40 years of science
at the



institute for transuranium elements

≈ 300 staff

Budget: 35 M€a

**Competitive income:
5...6 M€a**

Actinides

5f-electrons

1	2																	13	14	15	16	17	18																																											
1a	1a																	11a	11a	11a	11a	11a	11a																																											
1 H 1.0079 -239.14 -252.87 2.2 -1, 1 1s																								2 He 4.0026 -272.3 -168.93 1s ²																																										
3 Li 6.941 180.54 1347 1.0 He 2s ¹	4 Be 9.0122 1278 2970 1.5 He 2s ²																	5 B 10.811 2071 3367 2.0 He 2s ² 2p ¹	6 C 12.011 3667 4807 1.5 He 2s ² 2p ²	7 N 14.007 3497 495.8 1.5 He 2s ² 2p ³	8 O 15.999 3497 -218.4 1.5 He 2s ² 2p ⁴	9 F 18.998 299.62 -168.14 1.5 He 2s ² 2p ⁵	10 Ne 20.18 -248.47 -168.65 1.5 He 2s ² 2p ⁶																																											
11 Na 22.990 97.81 82.9 1.0 Ne 3s ¹	12 Mg 24.305 648.8 1090 1.2 Ne 3s ²																	13 Al 26.982 460.37 2467 1.5 Ne 3s ² 3p ¹	14 Si 28.086 359.7 2355 1.7 Ne 3s ² 3p ²	15 P 30.974 309.7 2355 1.7 Ne 3s ² 3p ³	16 S 32.06 320.6 2355 1.7 Ne 3s ² 3p ⁴	17 Cl 35.453 349.6 2355 1.7 Ne 3s ² 3p ⁵	18 Ar 39.948 -189.2 -185.7 1.8 Ne 3s ² 3p ⁶																																											
19 K 39.098 63.65 839 1.0 Ar 4s ¹	20 Ca 40.078 84.4 1484 1.0 Ar 4s ²																	21 Sc 44.956 150 1278 1.2 Ar 3d ¹ 4s ²	22 Ti 47.88 134.4 1344 1.2 Ar 3d ² 4s ²	23 V 50.942 181 1312 1.2 Ar 3d ³ 4s ²	24 Cr 51.996 189.7 1312 1.2 Ar 3d ⁵ 4s ¹	25 Mn 54.938 177 1312 1.2 Ar 3d ⁵ 4s ²	26 Fe 55.845 153.9 1312 1.2 Ar 3d ⁶ 4s ²	27 Co 58.933 153.9 1312 1.2 Ar 3d ⁷ 4s ²	28 Ni 58.693 153.9 1312 1.2 Ar 3d ⁸ 4s ²	29 Cu 63.546 100.1 1312 1.2 Ar 3d ¹⁰ 4s ¹	30 Zn 65.39 100.1 1312 1.2 Ar 3d ¹⁰ 4s ²	31 Ga 69.723 29.76 2355 1.0 Ar 3d ¹⁰ 4s ² 4p ¹	32 Ge 72.64 29.76 2355 1.0 Ar 3d ¹⁰ 4s ² 4p ²	33 As 74.922 29.76 2355 1.0 Ar 3d ¹⁰ 4s ² 4p ³	34 Se 78.96 29.76 2355 1.0 Ar 3d ¹⁰ 4s ² 4p ⁴	35 Br 79.904 29.76 2355 1.0 Ar 3d ¹⁰ 4s ² 4p ⁵	36 Kr 83.80 -153.3 -153.3 1.2 Ar 3d ¹⁰ 4s ² 4p ⁶																																	
37 Rb 85.468 38.89 1384 1.0 Kr 5s ¹	38 Sr 87.62 38.89 1384 1.0 Kr 5s ²	39 Y 88.906 38.89 1384 1.0 Kr 4d ¹ 5s ²	40 Zr 91.224 38.89 1384 1.0 Kr 4d ² 5s ²	41 Nb 92.906 38.89 1384 1.0 Kr 4d ⁴ 5s ¹	42 Mo 95.94 38.89 1384 1.0 Kr 4d ⁵ 5s ¹	43 Tc 98.906 38.89 1384 1.0 Kr 4d ⁵ 5s ²	44 Ru 101.07 38.89 1384 1.0 Kr 4d ⁷ 5s ¹	45 Rh 102.91 38.89 1384 1.0 Kr 4d ⁸ 5s ¹	46 Pd 106.42 38.89 1384 1.0 Kr 4d ¹⁰	47 Ag 107.87 38.89 1384 1.0 Kr 4d ¹⁰ 5s ¹	48 Cd 112.41 38.89 1384 1.0 Kr 4d ¹⁰ 5s ²	49 In 114.82 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ¹	50 Sn 118.71 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ²	51 Sb 121.76 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ³	52 Te 127.60 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ⁴	53 I 126.91 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ⁵	54 Xe 131.29 38.89 1384 1.0 Kr 4d ¹⁰ 5s ² 5p ⁶	55 Cs 132.91 38.89 1384 1.0 Xe 6s ¹	56 Ba 137.33 38.89 1384 1.0 Xe 6s ²	57 La 138.91 38.89 1384 1.0 Xe 4f ¹ 5d ¹ 6s ²	58 Ce 140.12 38.89 1384 1.0 Xe 4f ¹ 5d ¹ 6s ²	59 Pr 140.91 38.89 1384 1.0 Xe 4f ³ 6s ²	60 Nd 144.24 38.89 1384 1.0 Xe 4f ⁴ 6s ²	61 Pm 144.91 38.89 1384 1.0 Xe 4f ⁵ 6s ²	62 Sm 150.36 38.89 1384 1.0 Xe 4f ⁶ 6s ²	63 Eu 151.96 38.89 1384 1.0 Xe 4f ⁷ 6s ²	64 Gd 157.25 38.89 1384 1.0 Xe 4f ⁷ 5d ¹ 6s ²	65 Tb 158.93 38.89 1384 1.0 Xe 4f ⁹ 6s ²	66 Dy 162.50 38.89 1384 1.0 Xe 4f ¹⁰ 6s ²	67 Ho 164.93 38.89 1384 1.0 Xe 4f ¹¹ 6s ²	68 Er 167.26 38.89 1384 1.0 Xe 4f ¹² 6s ²	69 Tm 168.93 38.89 1384 1.0 Xe 4f ¹³ 6s ²	70 Yb 173.04 38.89 1384 1.0 Xe 4f ¹⁴ 6s ²	71 Lu 174.97 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹ 6s ²	72 Hf 178.49 38.89 1384 1.0 Xe 4f ¹⁴ 5d ² 6s ²	73 Ta 180.95 38.89 1384 1.0 Xe 4f ¹⁴ 5d ³ 6s ²	74 W 183.84 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁴ 6s ²	75 Re 186.21 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁵ 6s ²	76 Os 190.23 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁶ 6s ²	77 Ir 192.22 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁷ 6s ²	78 Pt 195.08 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁸ 6s ²	79 Au 196.97 38.89 1384 1.0 Xe 4f ¹⁴ 5d ⁹ 6s ¹	80 Hg 200.59 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ²	81 Tl 204.38 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹	82 Pb 207.2 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ²	83 Bi 208.98 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ³	84 Po 209 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁴	85 At 209 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁵	86 Rn 222.02 38.89 1384 1.0 Xe 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁶	87 Fr 223.02 38.89 1384 1.0 Rn 7s ¹	88 Ra 226.03 38.89 1384 1.0 Rn 7s ²	89 Ac 227.03 38.89 1384 1.0 Rn 6d ¹ 7s ²	90 Th 232.04 38.89 1384 1.0 Rn 6d ² 7s ²	91 Pa 231.04 38.89 1384 1.0 Rn 5f ² 6d ¹ 7s ²	92 U 238.03 38.89 1384 1.0 Rn 5f ³ 6d ¹ 7s ²	93 Np 237.05 38.89 1384 1.0 Rn 5f ⁴ 6d ¹ 7s ²	94 Pu 244.06 38.89 1384 1.0 Rn 5f ⁶ 6d ¹ 7s ²	95 Am 243.06 38.89 1384 1.0 Rn 5f ⁷ 7s ²	96 Cm 247.07 38.89 1384 1.0 Rn 5f ⁷ 6d ¹ 7s ²	97 Bk 247.07 38.89 1384 1.0 Rn 5f ⁷ 7s ²	98 Cf 251.08 38.89 1384 1.0 Rn 5f ¹⁰ 7s ²	99 Es 252.08 38.89 1384 1.0 Rn 5f ¹¹ 7s ²	100 Fm 257.10 38.89 1384 1.0 Rn 5f ¹² 7s ²	101 Md 258.10 38.89 1384 1.0 Rn 5f ¹³ 7s ²	102 No 259.10 38.89 1384 1.0 Rn 5f ¹⁴ 7s ²	103 Lr 262.11 38.89 1384 1.0 Rn 5f ¹⁴ 6d ¹ 7s ²

DB Dubnium

JI Joliotium

RF Rutherfordium

SB Seaborgium

HE Hassium

MT Meitnerium

** IUPAC Empfehlung

IUPAC Recommendation

(Pure and Appl. Chem., 55, 2423-2444, 1994)

W 7801005

Merck KGaA, 64271 Darmstadt, Germany

90 Th 232.04 1750 4790 1.1 Rn 6d ² 7s ²	91 Pa 231.04 1600 4790 1.1 Rn 5f ² 6d ¹ 7s ²	92 U 238.03 1132 3818 1.2 Rn 5f ³ 6d ¹ 7s ²	93 Np 237.05 640 3902 1.2 Rn 5f ⁴ 6d ¹ 7s ²	94 Pu 244.06 641 3232 1.2 Rn 5f ⁶ 7s ²	95 Am 243.06 2607 2607 ~1.2 Rn 5f ⁷ 7s ²	96 Cm 247.07 1340 2607 ~1.2 Rn 5f ⁷ 6d ¹ 7s ²	97 Bk 247.07 ~1.2 Rn 5f ⁷ 7s ²	98 Cf 251.08 ~1.2 Rn 5f ¹⁰ 7s ²	99 Es 252.08 ~1.2 Rn 5f ¹¹ 7s ²	100 Fm 257.10 ~1.2 Rn 5f ¹² 7s ²	101 Md 258.10 ~1.2 Rn 5f ¹³ 7s ²	102 No 259.10 ~1.2 Rn 5f ¹⁴ 7s ²	103 Lr 262.11 ~1.2 Rn 5f ¹⁴ 6d ¹ 7s ²
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Transuranium Elements

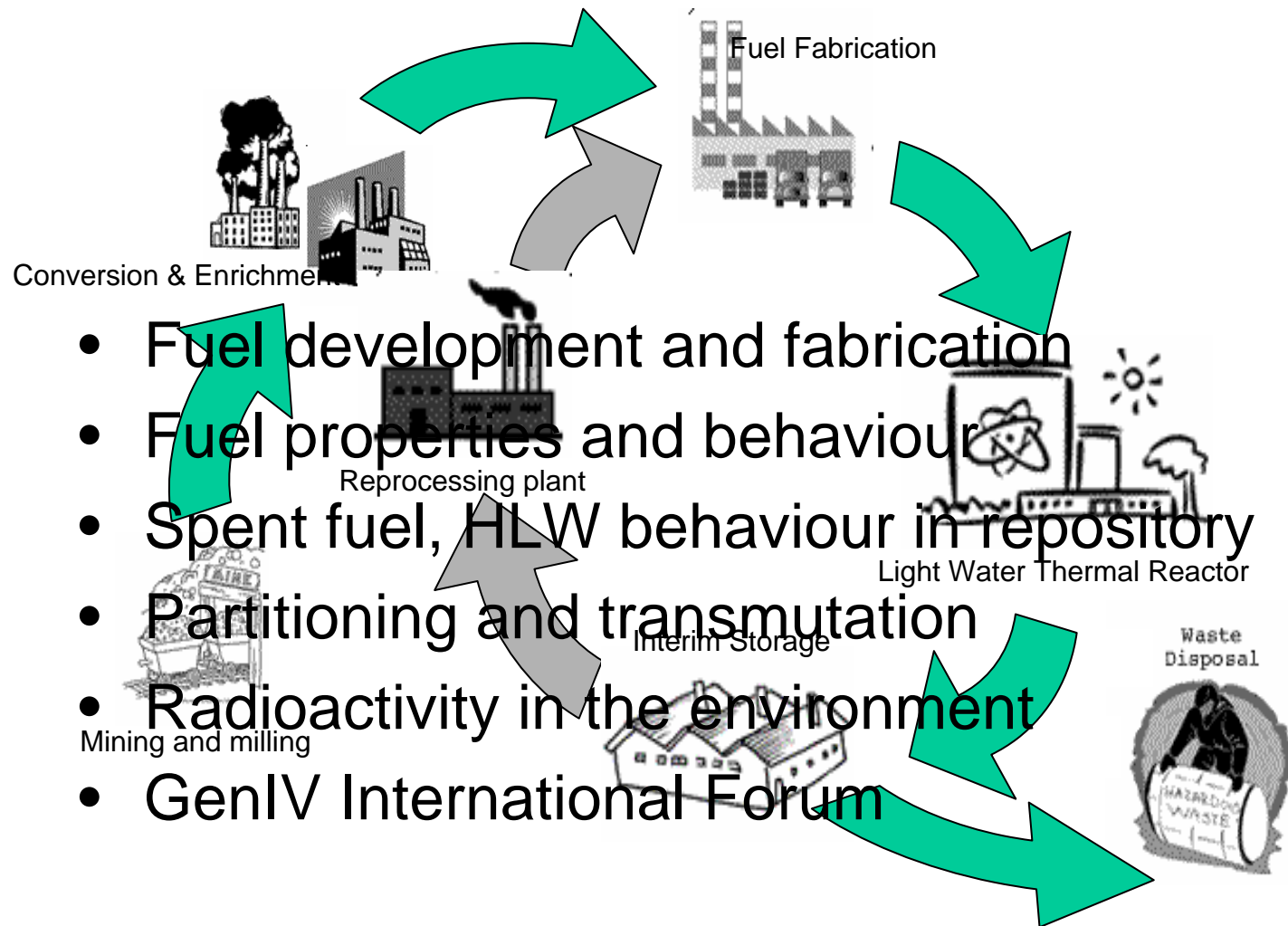
Safety of
the nuclear
fuel cycle

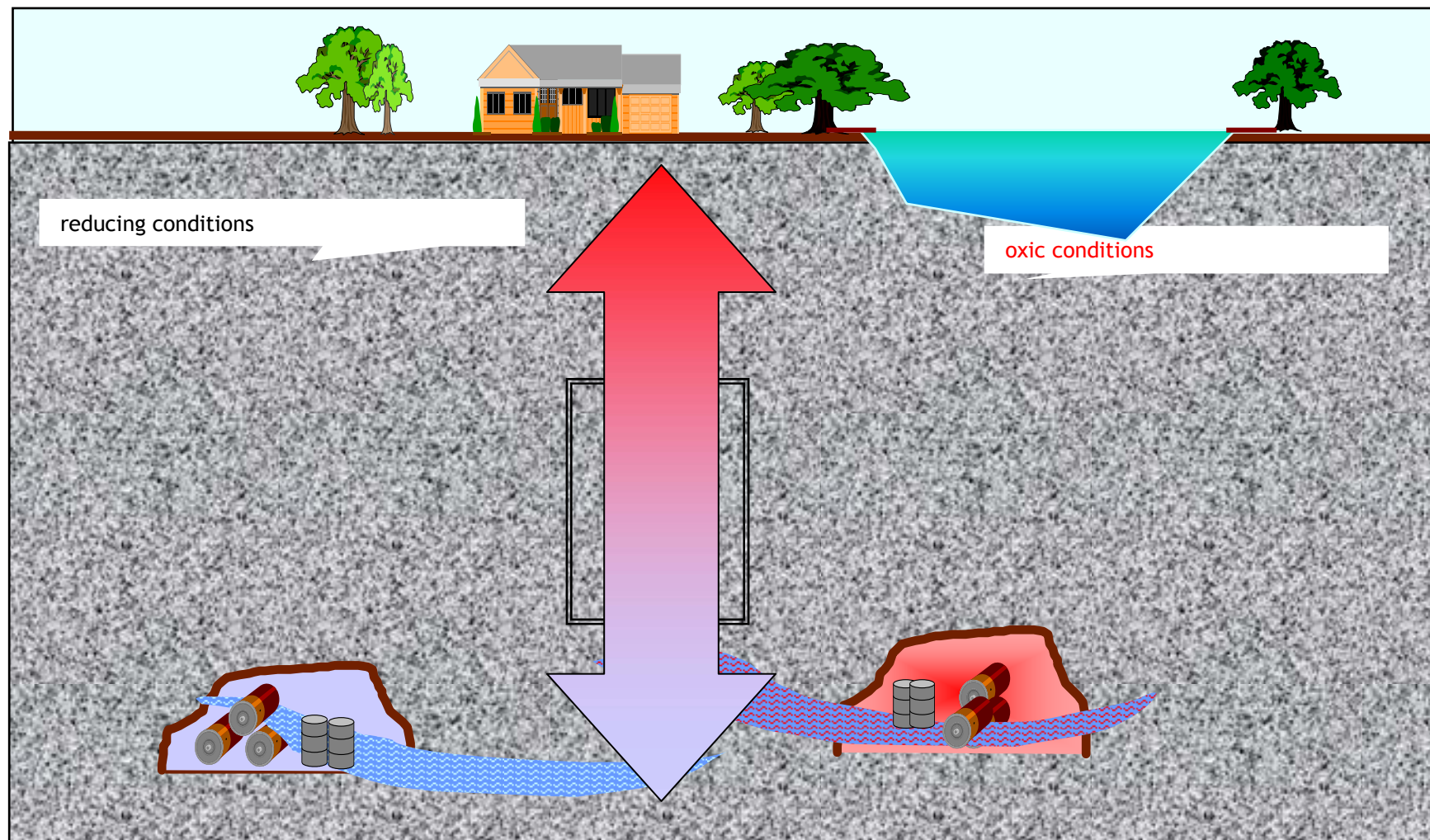
Safeguards
and
nuclear
forensics

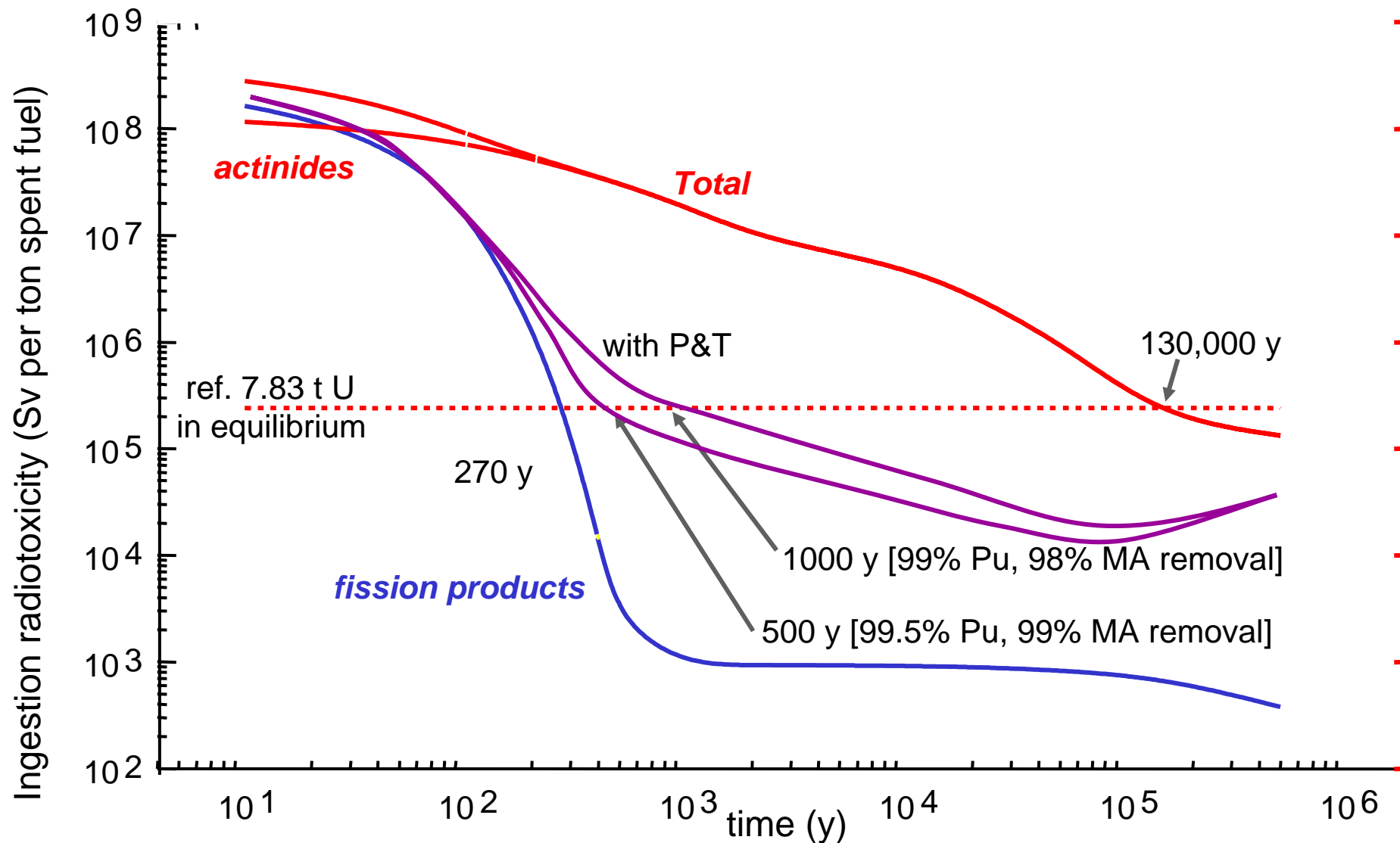
Basic
actinide
science and
applications

Education
and user
facilities

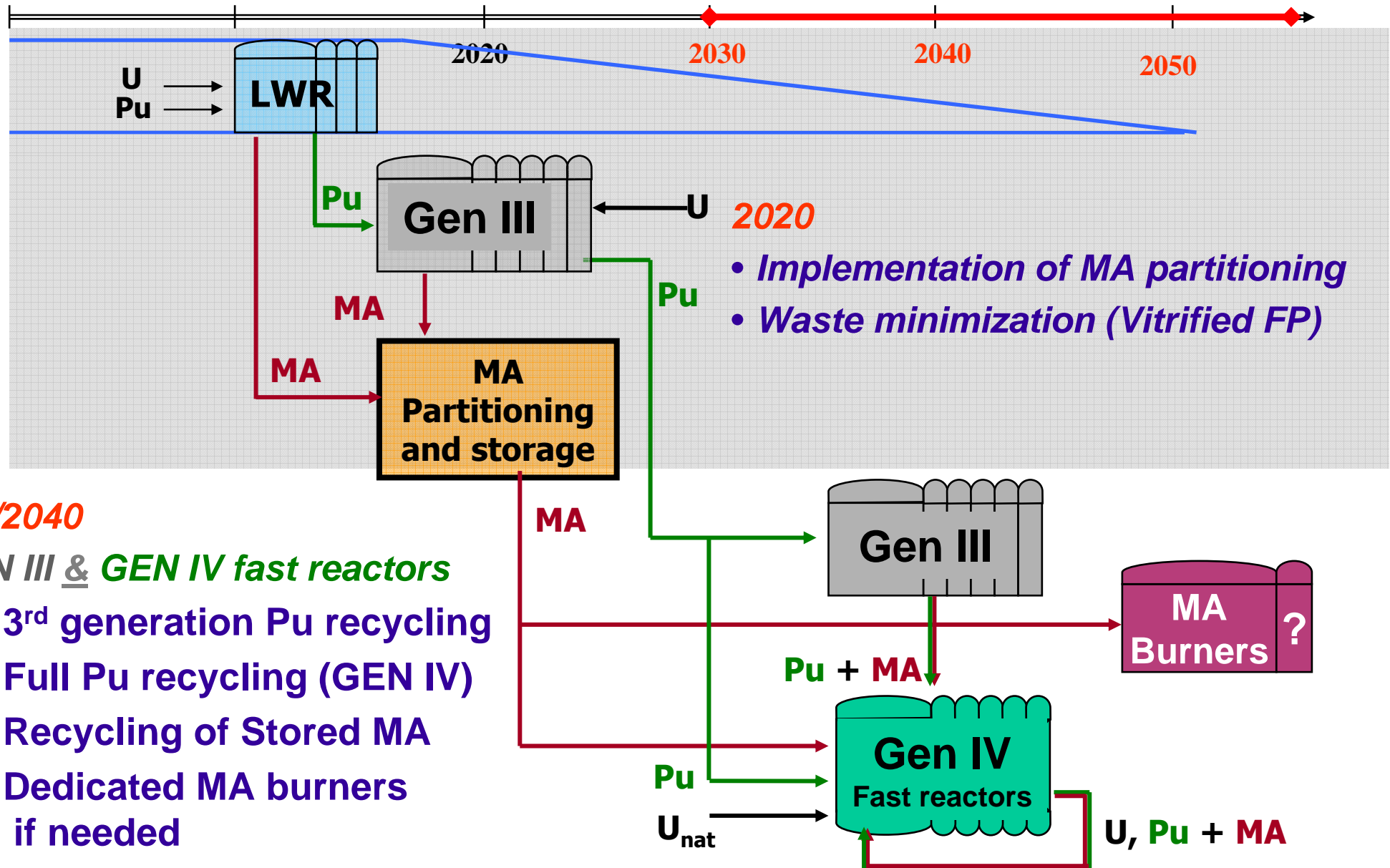
Safety of
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fuel cycle







evaluation by CEA, FZK and ITU based on ICRP72



Safety of
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Safety of
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Safeguards
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- R & D in the areas of chemical and radiometric methods for Plutonium facilities (reprocessing and fuel fabrication) and new fuel cycles
- Operation of the On-Site Laboratories (BNG, AREVA)
- Combating illicit trafficking (co-operation with new EU MS, CIS countries, IAEA,...)
- Nuclear forensics analysis of seized nuclear Material
- Micro-particle analysis (U enrichment) for the detection of clandestine nuclear activities: SIMS

Safety of
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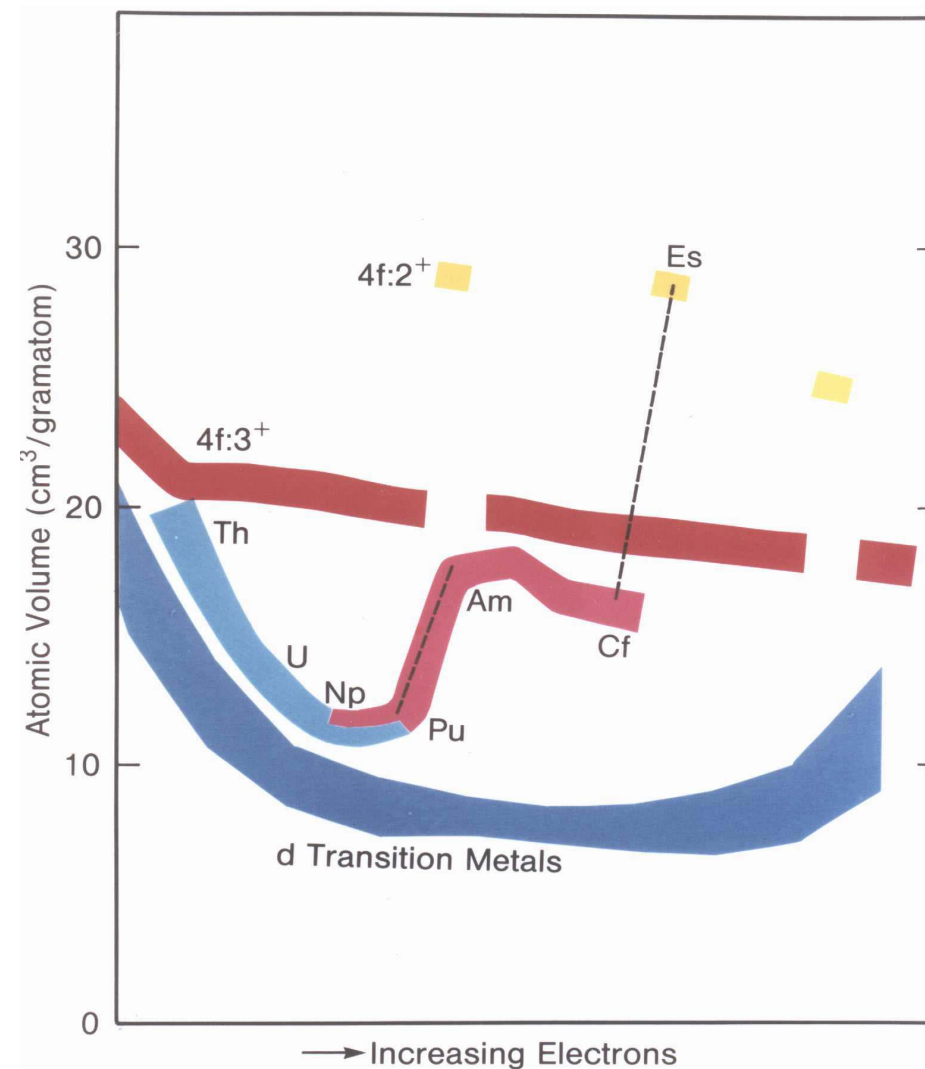
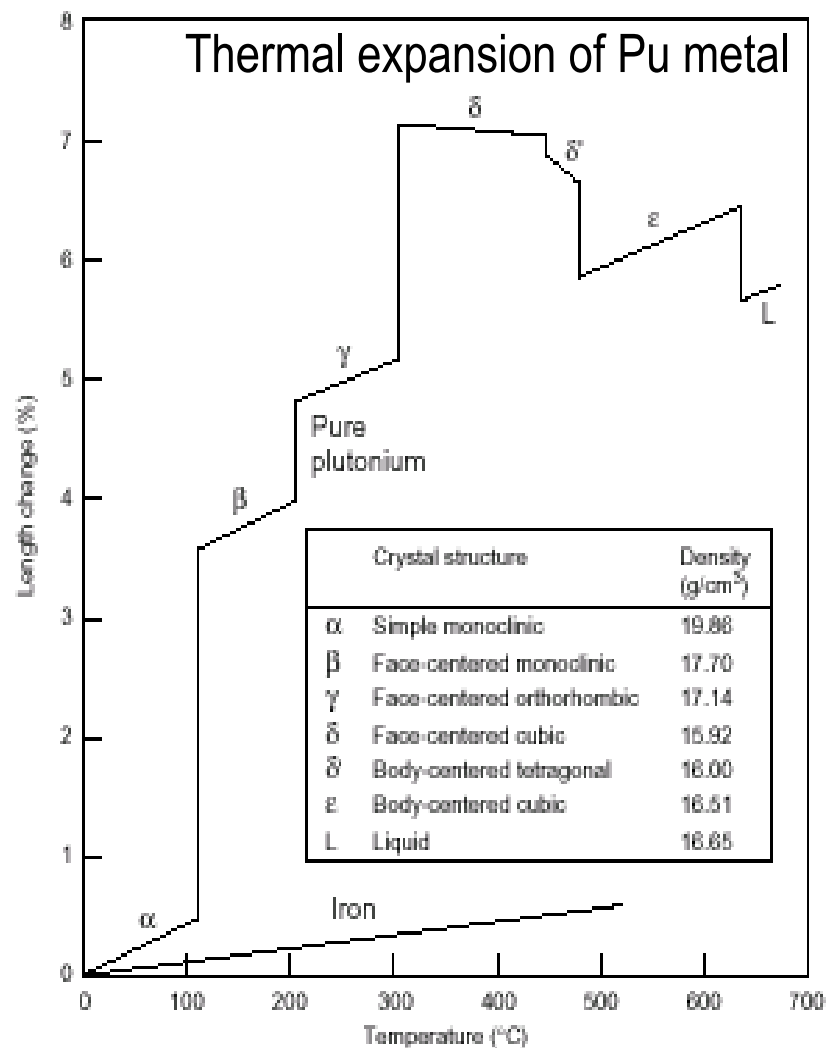
90 *232.04 1750 4790 1.1 Th 4 Rn 6d ² 7s ²	91 *231.04 1600 Pa 4, 5 Rn 5f ⁶ d ¹ 7s ²	92 *238.03 1132 3818 1.2 U 3, 4, 5, 6 Rn 5f ⁶ d ¹ 7s ²	93 *237.05 640 3902 1.2 Np 3, 4, 5, 6 Rn 5f ⁶ d ¹ 7s ²	94 *244.06 641 3232 1.2 Pu 3, 4, 5, 6 Rn 5f ⁶ 7s ²	95 *243.06 994 2607 ~1.2 Am 3, 4, 5, 6 Rn 5f ⁷ 7s ²	96 *247.07 1340 Cm 3, 4 Rn 5f ⁷ 6d ¹ 7s ²	97 *247.07 ~1.2 Bk 3, 4 Rn 5f ⁷ 7s ²	98 *251.08 ~1.2 Cf 3, 4 Rn 5f ⁸ 7s ²	99 *252.08 ~1.2 Es 3 Rn 5f ⁸ 7s ²	100 *257.10 ~1.2 Fm 3 Rn 5f ⁹ 7s ²	101 *258.10 ~1.2 Md 3 Rn 5f ¹⁰ 7s ²	102 *259.10 No 2, 3 Rn 5f ¹⁰ 7s ²	103 *262.11 Lr 3 Rn 5f ¹¹ 6d ¹ 7s ²
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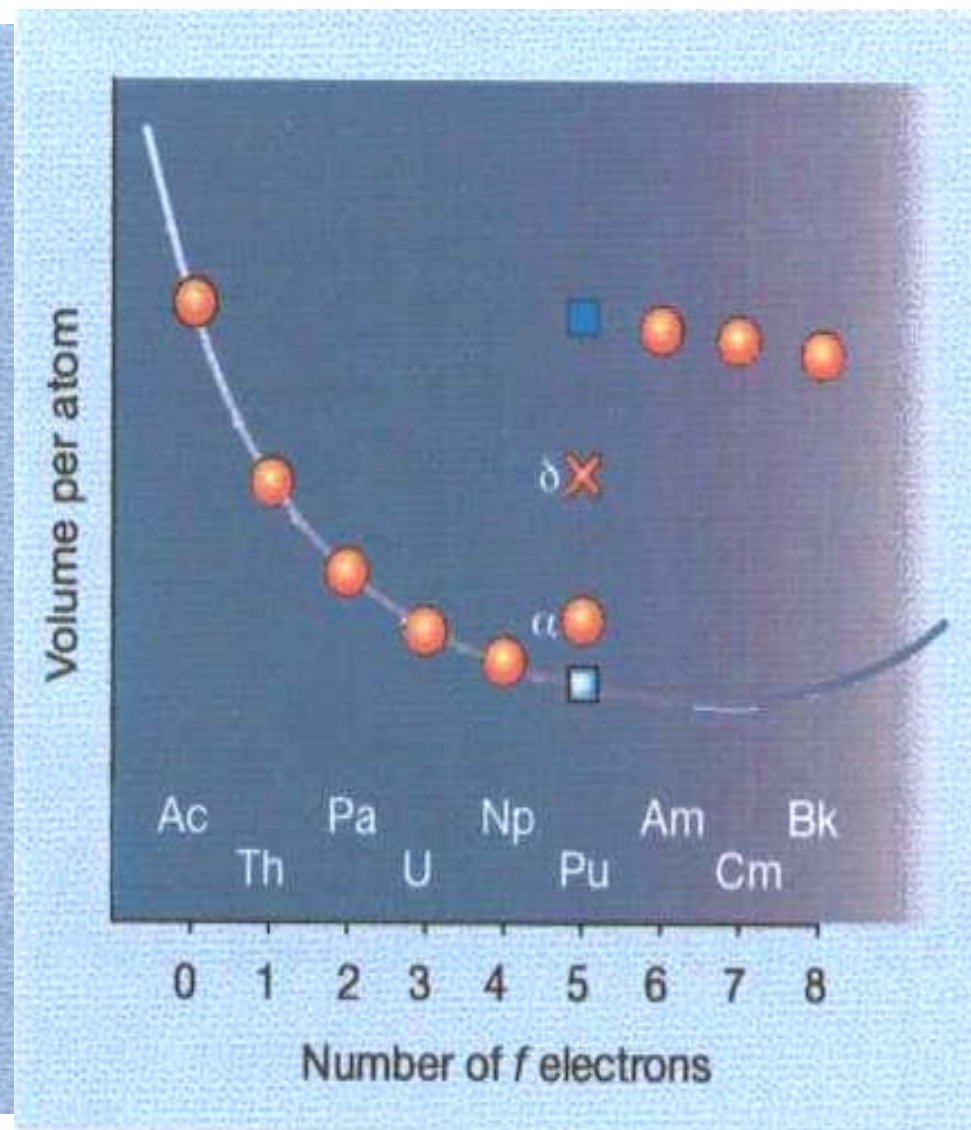
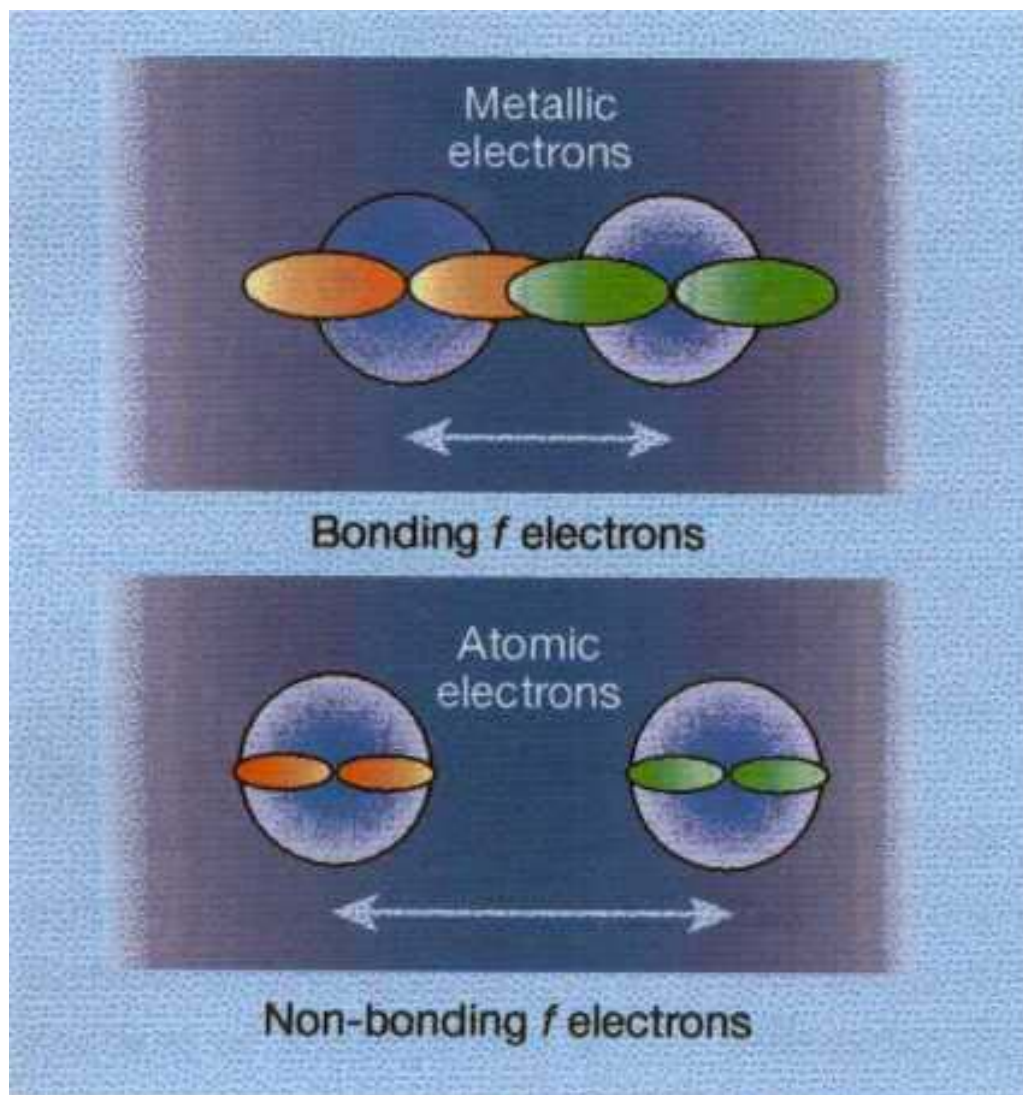
Safety of
the nuclear
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Safeguards
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Basic
actinide
science and
applications

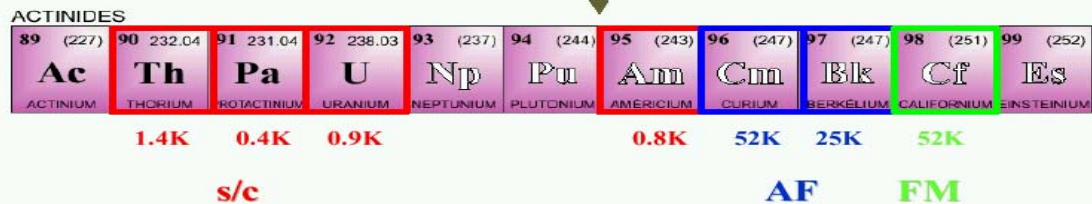
Education
and user
facilities





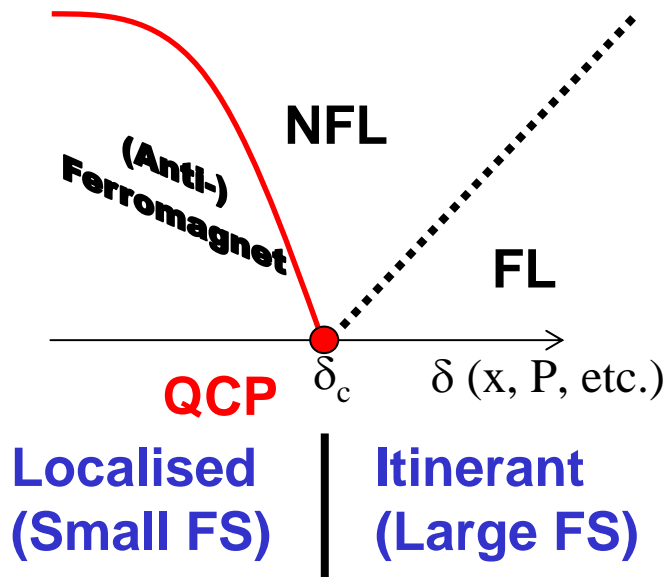
Superconductivity among 5f elements

Localisation

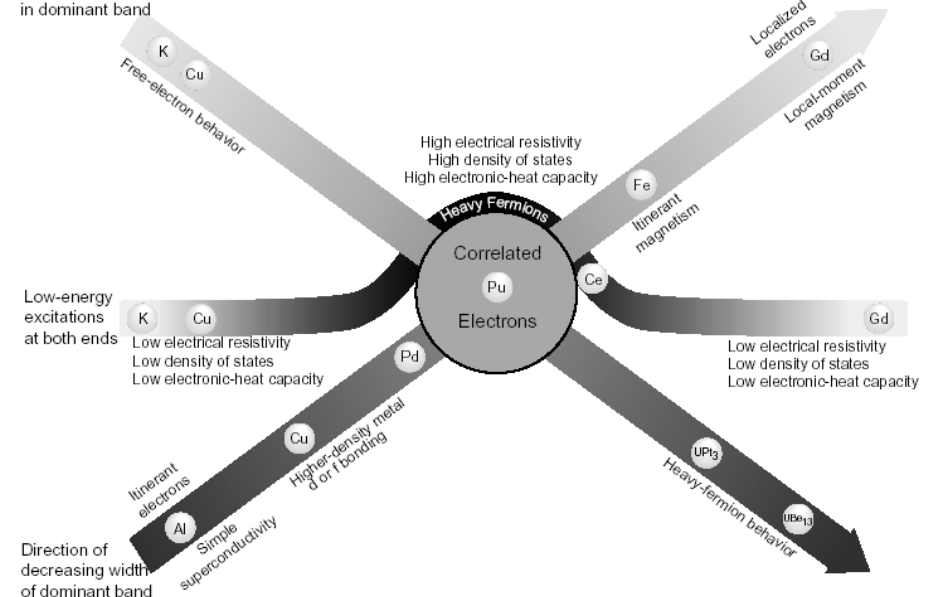


Itinerant – localised
crossover

near Pu in 5f electrons



Direction of increasing
electron correlations
in dominant band



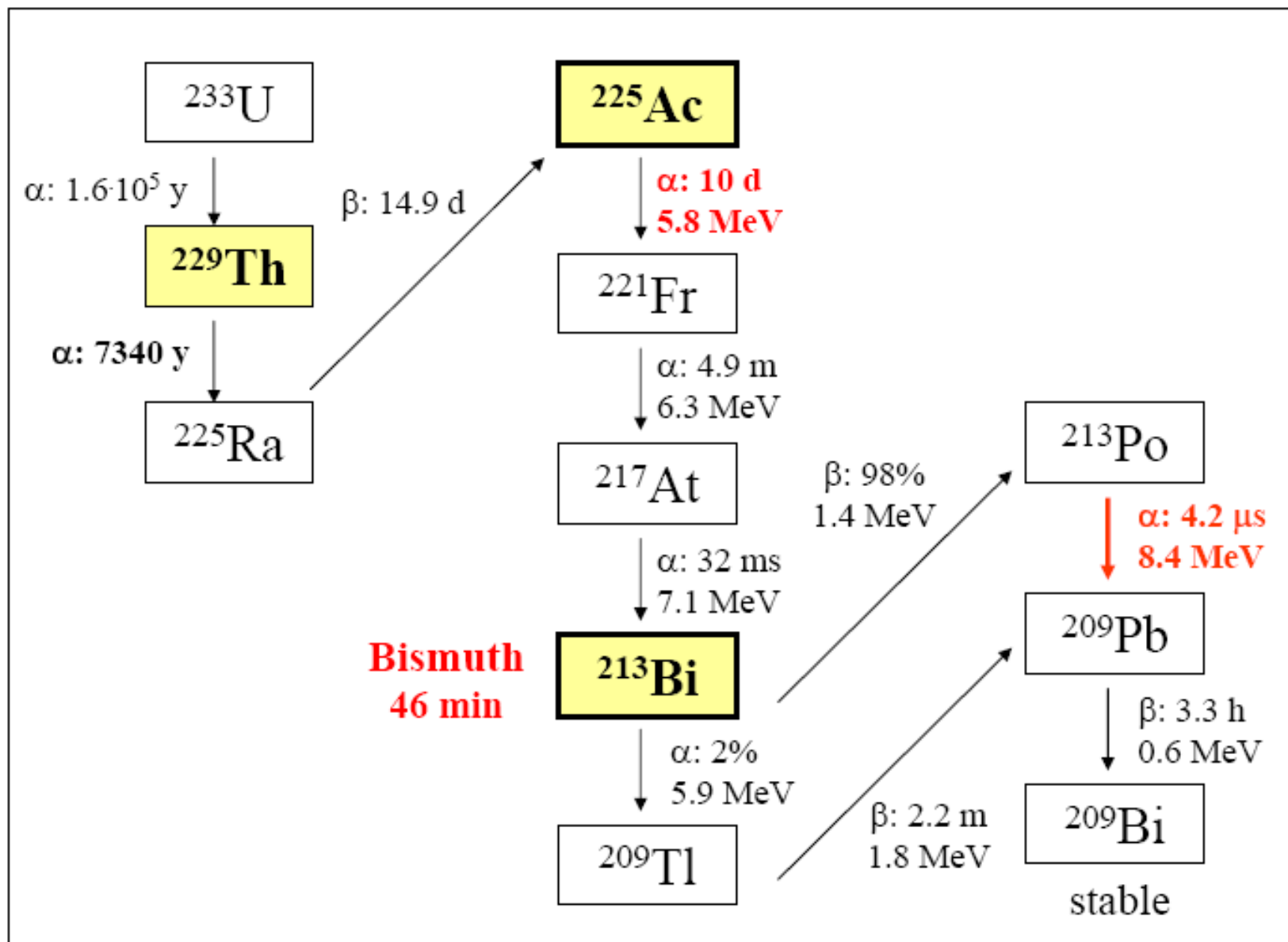
90 *232.04 1750 4790 1.1 Th 4 Rn 6d ² 7s ²	91 *231.04 1600 Pa 4, 5 Rn 5f ⁶ d ¹ 7s ²	92 *238.03 1132 3818 1.2 U 3, 4, 5, 6 Rn 5f ⁶ d ¹ 7s ²	93 *237.05 640 3902 1.2 Np 3, 4, 5, 6 Rn 5f ⁶ d ¹ 7s ²	94 *244.06 641 3232 1.2 Pu 3, 4, 5, 6 Rn 5f ⁶ 7s ²	95 *243.06 994 2607 ~1.2 Am 3, 4, 5, 6 Rn 5f ⁷ 7s ²	96 *247.07 1340 Cm 3, 4 Rn 5f ⁷ 6d ¹ 7s ²	97 *247.07 ~1.2 Bk 3, 4 Rn 5f ⁷ 7s ²	98 *251.08 ~1.2 Cf 3, 4 Rn 5f ⁸ 7s ²	99 *252.08 ~1.2 Es 3 Rn 5f ⁸ 7s ²	100 *257.10 ~1.2 Fm 3 Rn 5f ⁹ 7s ²	101 *258.10 ~1.2 Md 3 Rn 5f ¹⁰ 7s ²	102 *259.10 2, 3 No Rn 5f ¹⁰ 7s ²	103 *262.11 3 Lr Rn 5f ¹¹ 6d ¹ 7s ²
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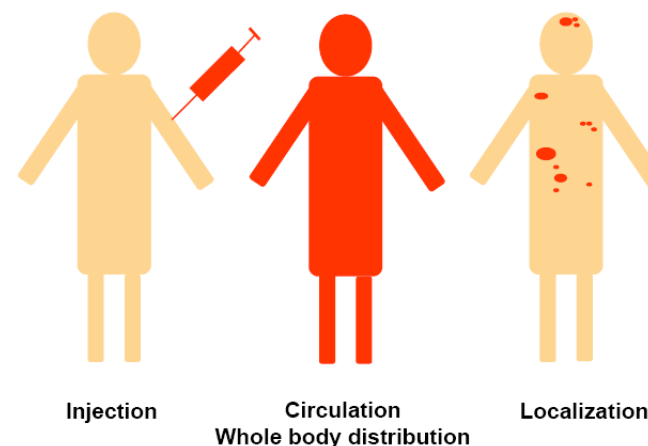
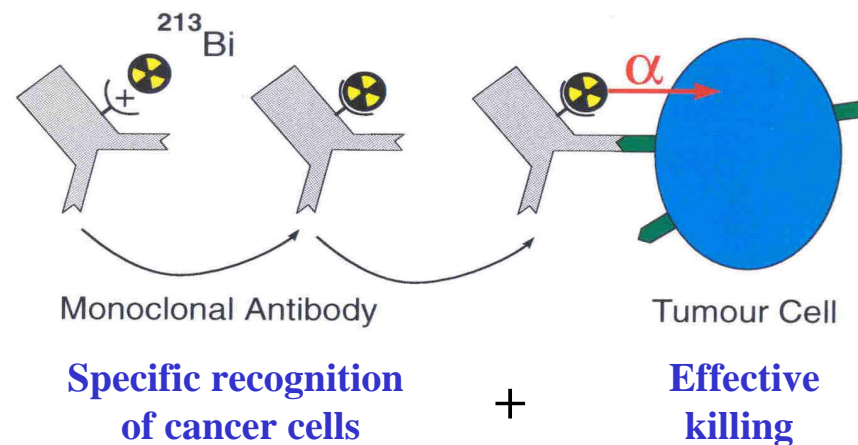
Education
and user
facilities



Alpha-immunotherapy for malignant diseases

Cancer therapy with α -emitters is more effective than β , γ treatments (micro-metastasis)

ITU is specialised in handling highly radioactive, in particular α -nuclides

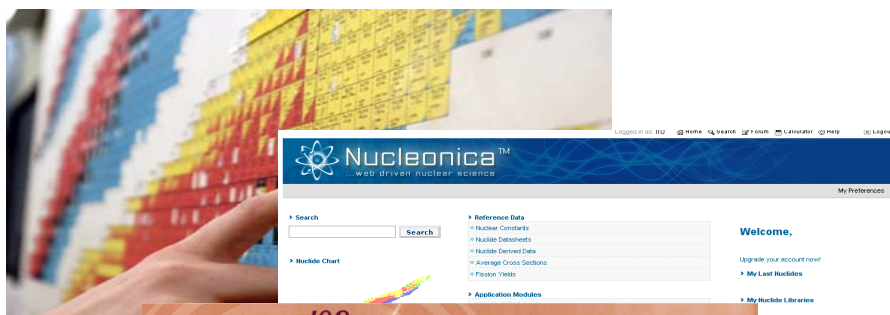


Basic
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Education
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• Summer Schools

ACTINET Summer School 2008

www.actinet-network.org

• Trainees, PhD students, Post-Docs

• Visiting scientists

• User Facility: **Actinide User Laboratory**

• Network of excellence **Actinet**

• Workshops and training courses

• Conferences

38 Journées des Actinides

www.int.pan.wroc.pl/38jda

Plutonium Futures "The Science" 2008

www.pu2008.org

• Upgrade and new nuclear databases

• Information portals

A graphic featuring four stylized human figures standing in a row. Each figure is constructed from various national flags, with the head, torso, and limbs represented by different flag patterns. They are positioned in front of a large European Union flag, which has a blue background with twelve yellow stars arranged in a circle. The text 'Tank you for your attention' is superimposed over the figures and the EU flag in a large, orange, outlined font.

Tank you for your attention